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13 ABSTRACT

Concepts are introduced for testing construction, support and service equipment.

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Materiel Test Procedure 9-1-601
General Equipment Test Activity

U. S. ARMY TEST AND EVALUATION COMMAND
BACKGROUND DOCUMENT

CONSTRUCTION, SUPPORT, AND SERVICE EQUIPMENT

1. INTRODUCTION

The increased mobility requirements of today's Army have created a demand for rapidly deployed and flexible troop transport equipment. Equipment is needed for temporary and permanent bridging of waterways, storing and distributing POL products, constructing roadways, housing of personnel and equipment, and completing related service functions. These items must be thoroughly tested both by an engineering and a service test facility to insure their suitability for Army use consistent with their expected operational requirements.

The engineering test facility determines the technical characteristics of the test item using laboratory test techniques and equipment, to determine the degree to which the test item meets the technical characteristics specified in the Materiel Need (MN), evaluates the maintenance requirements, and determines whether the item is safe for use by troops during service testing. A subjective evaluation of the test item's suitability for use by the Army is made during service testing. This testing is characterized primarily by qualitative observations and evaluations of operating materiel by selected military personnel having a background of field experience with the type of materiel undergoing test.

2. BACKGROUND DATA

2.1 POL SUPPORT EQUIPMENT

a. During any conflict, one of the critical deciding factors of the outcome is the availability of support materiel, and especially POL support materiel. For example, in the European Theater during World War II, approximately 50 percent of the total logistical tonnage was petroleum fuels; during the Korean conflict and in support of the conflict in Southeast Asia this figure increased about 60 percent.

b. It is envisaged that in the event of a future large-scale military operation, during conventional type warfare, fuel will be supplied in bulk up to or near front lines. It is contemplated that packaged fuels (5-gallon cans and 55-gallon drums) will only be used as a supplement to bulk supply methods in forward areas not accessible to bulk fuel transporters or in rapidly advancing situations when additional quantities of fuels may be needed to exploit a tactical situation.

c. In handling POL products the areas of greatest concern, aside from satisfactorily storing and dispersing the fluids in personal safety, is maintaining proper level of fluid cleanliness. This concern begins at the time of POL arrival and does not end until the products are expended. All handling,

storage and active (pumping, switching, measuring) devices must be safeguarded against sparking and operating personnel must guard against open flames, ignited cigarettes, and other igneous substances in proximity to the POL products.

d. An increasingly popular method of unloading tankers is through submarine hoseline. In selecting such implements care must be taken to ensure hoseline flexibility (so that the hoseline can be raised from the ocean floor to the tanker without suffering damage), resistance to aging (due to POL products, water, air, and sunlight), and compatibility with the tanker output connectors. When the hoseline is submerged, a capping mechanism must be used to prevent water from entering the line.

e. On arriving at the trunkline from the submerged lines, the POL products are pumped to and stored at tank farms. These farms are usually permanent installations consisting of any number of large permanent storage barrels interconnected to the output trunkline by one or more pipeline manifolds. When requirements exist for the stored products, the manifold is activated to couple the desired tank to the output trunkline. The pipeline manifold must be a positive acting device easily actuated and able to withstand continual usage, environmental and POL aging, hydrostatic pressures imposed, and be compatible with all input, output and control lines.

f. Testing is therfore required to ensure that POL support equipment when incorporated into the Army's inventory will perform in the manner specified, achieve stated durability criteria, meet human factors handling considerations, and be compatible with existing hardware. Any instances wherein testing specified in the engineering or service test MTP's indicates a deficiency and/or shortcoming in the POL equipment, the anomaly shall be recorded and suitable recommendation made for action requisite to accepting the test item.

2.2 BRIDGING EQUIPMENT

a. The Army makes extensive use of fixed and portable (tactical) bridges to overcome water and land obstacles. Tactical bridges are used to facilitate rapid troop movement without consideration to subsequent need for bridging over the given obstacle. Fixed bridges are employed when the general area has been secured and requirements exist for continued traffic over the obstacle.

b. With tactical bridges, testing is completed to determine the ability of the equipment to be moved from site to site; agreement/disagreement of weight bearing capabilities with stated requirements; time, effort, and manpower required to install the test item; and ability of the equipment to continue to meet performance requirements with minimal downtime for maintenance. Typical testing consists of assembling or erecting the bridge, then in loading it and using the bridge in missions normal to its expected usage. A floating mobile assault bridge, for example, is evaluated for its maneuverability, and speed and towing power in addition to its ability to quickly and

effectively perform its bridging function. When the bridge is constructed from pontoons, testing is completed to determine the ease of transporting and assembling the bridge components, the supporting strength of the assembling the bridge components, the supporting strength of the assembled structure, and the durability of the structure in resisting environmental effects.

c. Fixed bridges are tested to determine the ease of erection in the given site and to ascertain their strength and durability characteristics. These bridges are constructed of concrete, steel support girders and interlocking roadway sections. Heavy construction and material handling equipment is used throughout the assemblage period. Difficulties in completing specified assembly procedures, misalignments of interconnecting structures, or inadequacies/difficiencies in material supplied are noted. After the bridge is completed extensive tests are conducted to determine its load bearing characteristics using strain gages, simulated and actual loads. Continual observations are made throughout the period of test to determine the effects of environment and continuous usage on bridge durability.

2.3 PREFABRICATED BUILDINGS

a. In considering prefabricated buildings, major concern lies in the ease of erecting the buildings and in determining the degree to which the completed building meets stated criteria. To determine the former, an evaluation of the ease in transporting and preparing the building material for assemblage is completed. Recommended tools, equipment and manpower, are made available and utilized according to the building instructions supplied. Difficulties, deficiencies and/or inadequacies in material or the descriptive literature supplied are noted together with all hazards and conditions of marginal safety, manpower, equipment, and time required to complete construction are recorded together with any recommendations for improvements in materials or procedures.

b. After completing a building, extensive testing is conducted to determine its suitabiltiy for its intended purpose in the intended environment. An administrative building, for example, will be loaded with furniture, filing cabinets, and 250 pound test weights to simulate administrative personnel. Strain gages are used to measure deformation of structural members to determine the safety of the building in support of the test activity. Rain, sandstorms and cold/hot temperatures are induced to determine their effect on the structure and its insulation and durability characteristics. Finally, an overall evaluation of the building is made which includes the foregoing points in addition to the suitability of layout to accommodate expected traffic-flow patterns, adaptability for varied uses and joining with other buildings to form a complex, and any other condition of specific usage.

2.4 CONSTRUCTION EQUIPMENT

a. The items in this category consist of heavy material handling equipment. These items are conveyor equipment, cranes, earth loading and

moving equipment, and highway paving equipment. All of these items perform interdependent functions and are tested in substantially the same manner. That is, tests are performed to determine the ease of operation and efficiency of the items in performance of their prime functions. All control and safety features are examined and compared with stated criteria; and durability and overload tests are completed to determine how well the item maintains its operational efficiency when subjected to controlled and specified overload abuses. In addition to these determinations, evaluations are continuously made as to the effect of the environment and work site on the operation and durability of the test item.

b. Dust, dirt, and sand developed during construction activities have a tendency to invade breathing mechanisms and filters shutting off air and even entering the interal cavities of engines scoring bearings, clogging passages and in general reducing the operating efficiency and life of the engine. These same materials act as cutting compounds on belts and bind and jam power transmitting gears and chains. Therefore, an important consideration in determining the usefulness of construction equipment is in evaluating the amount of downtime required for cleaning and removing accumulated grit and the construction material being processed.

c. Successful completion of engineering and service testing, therefore, assures that the item will meet or exceed its performance, durability and availability objectives when employed in a tactical environment by appropriately assigned field personnel.

2.5 GAS GENERATING AND CHARGING EQUIPMENT

a. Personal safety is of primary concern in testing gas generating and charging equipment. Hydrostatic cylinders are tested while enclosed in a safety jacket so that if the cylinders burst, the flying particles will not reach operating personnel. Other items in this series may not be so shielded and strict observance of safety procedures, regulations, and gage indications is required during testing. Any indications of possible cylinder and allied plumbing rupture should be answered with prompt action to shut the system down and safety release the overpressure condition. To this end, all safety and emergency devices should be tested and verified operable, insofar as possible, prior to initiating active testing. If the safety equipment and procedures supplied are questionable in value or condition or if an insufficient number of safety devices are furnished, active testing must be postponed until this condition is rectified or resolved in some other predetermined manner.

b. The physical properties of the majority of gases used by the Army requires that they be transported either as a liquid in refrigerated containers at low temperatures or as a gas in very heavy cylinders at high pressure. Under these conditions, transportation of large quantities of liquids and gases over great distances is a serious problem which is compounded by the fact that certain of these products may be poisonous, flammable, oxidizing, corrosive, or explosive and thereby considered a regulatory

commodity by the Interstate Commerce Commission. Presently, the only solution which will adequately satisfy military requirements for such gases as oxygen or nitrogen is to produce the gases in or near the area in which they are to be used. Therefore, unless otherwise specified, testing of gas generating equipment should be completed in carefully controlled areas minimizing the transport distances involved consistant with test requirements to minimize hazards to test and civilian personnel.

2.6 SHOP EQUIPMENT

a. Completing tactical mission almost always causes a reduction in tactical ready equipment. Inoperative equipment temporarily represents a greater liability to the Army than lack of such equipment since time, manpower, material and tools must be diverted to the equipment for repair. Therefore, it is of paramount importance to have effective field tools that can be quickly employed to repair inoperative equipment and restore the tactical strength of the units involved.

b. The shop equipment germane to Volume 9 is used to provide field maintenance of Army equipment. Each item is trailer mounted and either deployed to a forward maintenance area or to the disabled item to complete repairs. The shop equipment must be durable enough to withstand transport over rough roads and exposure to varied environments and not suffer loss of operability or precision. In addition, since the shop equipment may often be used in less than ideal circumstances, the equipment must be proven easy to use, safe, adaptable to varied requirements, and operable with minimal downtime for scheduled or unscheduled maintenance. Testing is completed to assure that the items involved, when employed in field conditions, will meet their performance and availability requirements when used by appropriately assigned field personnel.

2.7 WATERWAY EQUIPMENT

Bodies of water are obstacles that often must be overcome to complete tactical missions. These missions vary from clandestinely transporting one or two men to transporting hundreds of men and associated equipment by a single vehicle. Each vehicle must, therefore, be tested to insure that it can be operated and maintained such that stated performance, durability, safety and human factors criteria are achieved. For example, an inflatable landing boat must be stored for relatively long periods of time and then made operational at an area usually removed from the storage area. At the completion of the mission, the boat must be cleaned, collapsed, packaged, and again stored until subsequently deployed. Testing, in this instance, would be completed to determine such things as resistance of the boat to storage effects, ease of transporting and deploying the boat, ease and permanence of effecting repairs, stability of boat under various seas and amount and positions of loads, suitability of the boat for manpower or engine locomotion, and ease of repackaging and storing the boat. Once having successfully completed such test actions, reliance can be placed on the test item to meet those very same performance and availability criteria when employed in a tactical environment by combat personnel.

3. DATA REDUCTION AND PRESENTATION

a. The purpose of data reduction is to abstract the information contained in the qualitative and quantitative data collected during active testing and present this information such that it can be compared against stated criteria. Any means convenient for this comparison is used to display the collected information. Mose useful, however, are tabular and graphical forms.

b. Often formulae are employed to convert recorded data into a desired form or combine several pieces of data into a single result. Again, standard display means are employed to compare these results against stated criteria.

c. A third method for evaluating data collected is through statical interpretation. This method provides a means for extrapolating results obtained in accordance with the conditions under which data was collected, appropriate formulae, and previously established interpretative constants. Statical interpretation is useful, for example, in determining such things as reliability (probability that an item will perform its intended function for a specified interval under stated conditions) associated with a stated confidence level (probability that the actual performance will agree with the reliability estimate).